

CLAIMS

Therefore, having thus described the invention, at least the following is claimed:

- 1 1. A nanostructure, comprising:
2 a free-standing, helical semiconductor oxide nanostructure including a
3 nanobelt having a substantially rectangular cross-section, wherein the nanobelt is
4 about 5 nanometers to about 200 nanometers in width and about 3 nanometers to
5 about 50 nanometers in height, and wherein the radius of the helical
6 semiconductor oxide nanostructure is about 200 to 5000 nanometers.

- 1 2. The nanostructure of claim 1, wherein the semiconductor oxide is chosen from
2 oxides of zinc, cadmium, mercury, gallium, indium, tellurium, germanium, tin,
3 and lead.

- 1 3. The nanostructure of claim 1, wherein the semiconductor oxide is zinc oxide.

- 1 4. The nanostructure of claim 1, wherein the nanobelt is a single crystalline
2 structure.

- 1 5. The nanostructure of claim 1, wherein the nanobelt is a polar surface dominated
2 zinc oxide nanobelt.

- 1 6. The nanostructure of claim 1, wherein the nanobelt includes polarized $\pm(0001)$
2 facets.
- 1 7. The nanostructure of claim 1, wherein the nanobelt has a substantially uniform
2 width along the length of the free-standing helical semiconductor oxide
3 nanostructure.
- 1 8. The nanostructure of claim 1, wherein the semiconductor oxide is zinc oxide,
2 wherein the nanobelt has a top $\pm(0001)$ surface, bottom $\pm(0001)$ surface, a right
3 side $\pm(10\bar{1}0)$ surface, and a left side $\pm(10\bar{1}0)$ surface.
- 1 9. The nanostructure of claim 1, wherein the semiconductor oxide is zinc oxide,
2 wherein the nanobelt is described by characteristics selected from an interior
3 (0001) -Zn surface and an exterior $(000\bar{1})$ -O surface, and an interior surface
4 $(000\bar{1})$ -O and exterior surface (0001) -Zn.

- 1 10. A nanostructure comprising:
2 a free-standing semiconductor oxide nanoring, wherein the nanoring has a
3 radius of about 500 to 10,000 nanometers, a height of about 5 to 2000 nanometers,
4 and a width of about 50 to 7500 nanometers.
- 1 11. The nanostructure of claim 10, wherein the semiconductor is chosen from ZnS,
2 GaN, CdSe, and oxides of zinc, cadmium, gallium, indium, tin, lead, and, and
3 combinations thereof.
- 1 12. The nanostructure of claim 10, wherein the semiconductor oxide is zinc oxide.
- 1 13. The nanostructure of claim 12, wherein the nanoring includes a nanobelt having a
2 substantially rectangular cross-section, wherein the nanobelt is about 5
3 nanometers to about 200 nanometers in width and about 3 nanometers to about 50
4 nanometers in height.
- 1 14. The nanostructure of claim 13, wherein the nanoring includes about 1 to 250 loops
2 of the nanobelt.
- 1 15. The nanostructure of claim 13, wherein the semiconductor oxide is zinc oxide,
2 and wherein the nanobelt includes a top $\pm(0001)$ surface, a bottom $\pm(0001)$
3 surface, a right side $\pm(1\bar{2}10)$ surface, and a left side $\pm(1\bar{2}10)$ surface.

1 16. The nanostructure of claim 13, wherein the semiconductor oxide is zinc oxide,
2 wherein the nanobelt has an interior (0001)-Zn surface and an exterior $\pm(000\bar{1})$ -O
3 surface.

1 17. The nanostructure of claim 11, wherein the nanoring is a single crystalline
2 structure.

1 18. A method of preparing nanostructures comprising:
2 exposing a homogeneous metal oxide powder mixture to thermal
3 conditions of about 900 to 1600 °C at a pressure of about 10^{-3} to 10^{-2} torr for
4 about 5 to 100 minutes;
5 flowing an inert gas over the homogeneous metal oxide powder mixture;
6 and
7 forming a free-standing semiconductor oxide nanostructure via a
8 condensation reaction at a pressure of about 50 to 800 torr and at thermal
9 conditions of about 100 to 700 °C, each of the free-standing semiconductor oxide
10 nanostructures having a substantially rectangular cross-section.

1 19. The method of claim 18, wherein the homogeneous metal oxide powder mixture
2 is selected from zinc oxide, lithium oxide, lithium carbonate, indium oxide,
3 gallium oxide, and combinations thereof.

1 20. The method of claim 18, wherein the free-standing semiconductor oxide
2 nanostructure is a free-standing, helical semiconductor oxide nanostructure
3 including a nanobelt having a substantially rectangular cross-section, wherein the
4 nanobelt is about 5 nanometers to about 200 nanometers in width and about 3
5 nanometers to about 50 nanometers in height, and wherein the radius of the helical
6 semiconductor oxide nanostructure is about 200 to 5000 nanometers.

- 1 21. The method of claim 18, wherein the free-standing semiconductor oxide
- 2 nanostructure is a free-standing semiconductor oxide nanoring, wherein the
- 3 nanoring has a radius of about 500 to 10,000 nanometers, a height of about 5 to
- 4 2000 nanometers, and a width of about 50 to 7500 nanometers.